Ecological Indicators Related to Military Land Management

Virginia Dale and Pat Mulholland

Environmental Sciences Division, Oak Ridge National Laboratory

Aaron Peacock

Center for Biomarker Analysis, The University of Tennessee

August 2003

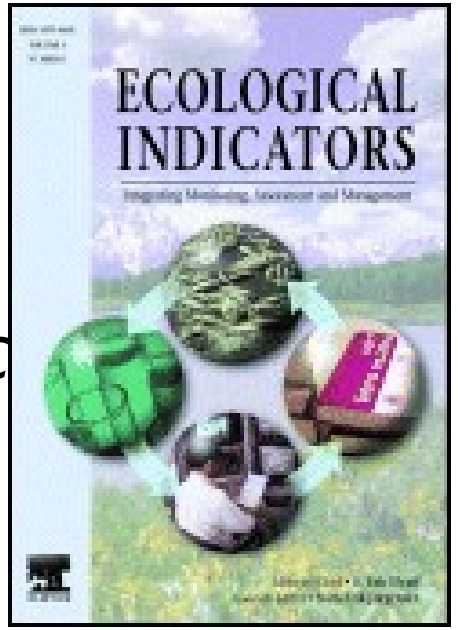
Ecological Society of America meeting

Session on

Ecosystem Management Challenges for Defense Installations

Indicators are Focus of Much Research

- New journal: *Ecological Indicators*
- Heinz report: *The State of the Nation's Ecosystems*
- National Academy report: *Ecologic Indicators for the Nation*
- EPA's *Report on the Environment*



But many efforts do not focus on level of resource management

Criteria for Indicators*

- Are easily measurable
- Are sensitive to stresses of system
- Respond to stress in a predictable manner
- Signify an impending change in key characteristics of the ecological system
- Experience changes that can be averted by management actions
- Together with the full suite of indicators, provide a measure of coverage of the key gradients across the ecological systems (e.g., soils, vegetation types, temperature, etc.)
- Have a known response to natural disturbances and changes over time
- Have low variability in response

* Dale, V.H and Beyeler, S.C. 2001. Challenges in the development and use of ecological indicators. *Ecological Indicators*, v.1

Focus on:

- Identifying indicators of ecological impacts of prior resource use or management.
- Determining how these indicators can be an integral part of the monitoring and management program of Fort Benning
- Developing a procedure for integration (so the approach could be adopted by other DoD installations)

Background

- Many “disturbances” occur at Fort Benn
  - Military training and testing
  - Timber harvest and thinning
  - Natural and anthropogenic fires
  - Insect outbreaks
  - Spread of introduced, invasive species
- Disturbances external to Fort Benning:
  - Land use change
  - Climate change
    - Warming and less precipitation
    - Changes to disturbance regimes (ice storms, hurricanes,

Background (continued)

- Much research on indicators is occurring at Fort Benning
  - Three SEMP indicator projects
  - Two SEMP threshold projects
  - Endangered species research

- Other research focuses on areas outside Fort Benning
  - Modeling of environmental impacts in region
  - Climate change projections

ornl
Oak Ridge National Laboratory

ERDP's SEMP

Background (continued)

- The Army has set priority conservation requirements
  1. Reducing Impacts of Threatened & Endangered Species (TES) on Military Training, Testing, and Other Operations
  2. Baseline Threatened & Endangered Species (TES) Inventories and Monitoring
  3. Land Capability/Characterization
  4. Land Rehabilitation
  5. Non-Native Invasive Species Control for Army Installations & Operations

Red cockaded woodpecker

Background (continued)

- Fort Benning has completed management plans
  - Integrated Natural Resource Management Plan (INRMP)
  - Installation Master Plan
  - Range plans: used to set forth training and testing activities
- Monitoring of disturbances and their effects is problematic
  - Projected training is only recorded at the compartment level
  - Army's LCTA (land condition trend analysis)
    - The few random points miss many impacts
    - Key indicators are missing

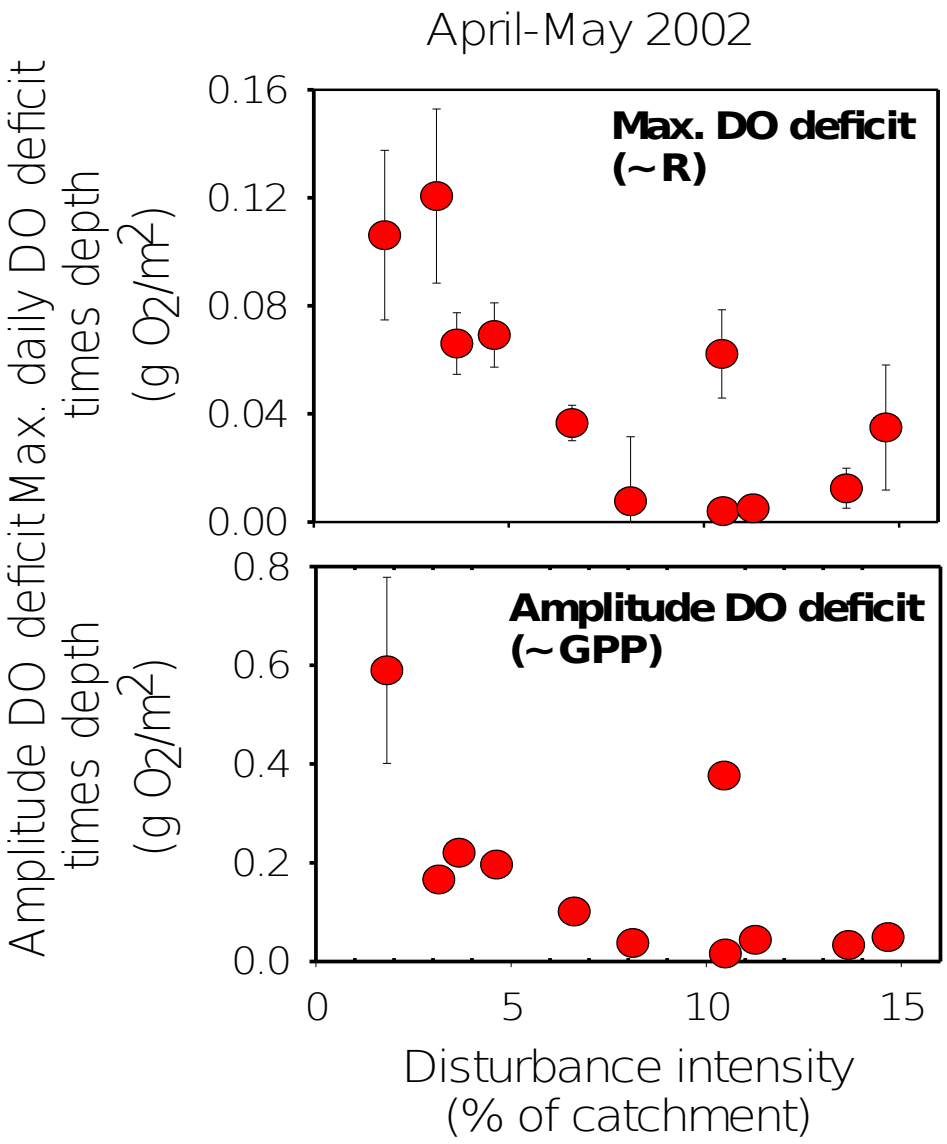
Some Candidate Indicators for Plot Scale

- Vegetation
  - Tree density & diversity
  - Understory cover & diversity
  - Cover by life form
- Soils
  - Depth of A horizon
  - Surface soil carbon concentration
  - Surface soil bulk density
- Animals
  - Ant community structure
- Soil fungi
- Multivariate metrics
  - Habitat canonical variate

Candidate Indicators at Catchment Scale

- Stream chemisty
  - Suspended sediment and nutrient concentrations
    - (indicator of erosion and biogeochemical status)
  - Diurnal dissolved oxygen profiles
    - (indicator of in-stream metabolism)
  - Streambed organic matter content
    - (indicator of food or habitat)
  - Sediment movement dynamics
    - (indicator of in-stream habitat stability or quality)
- Macroinvertebrate populations and communities
  - EPT richness
  - Shannon diversity
  - Biotic indices

Indicator of stream metabolism:
Maximum DO deficit, Amplitude DO deficit

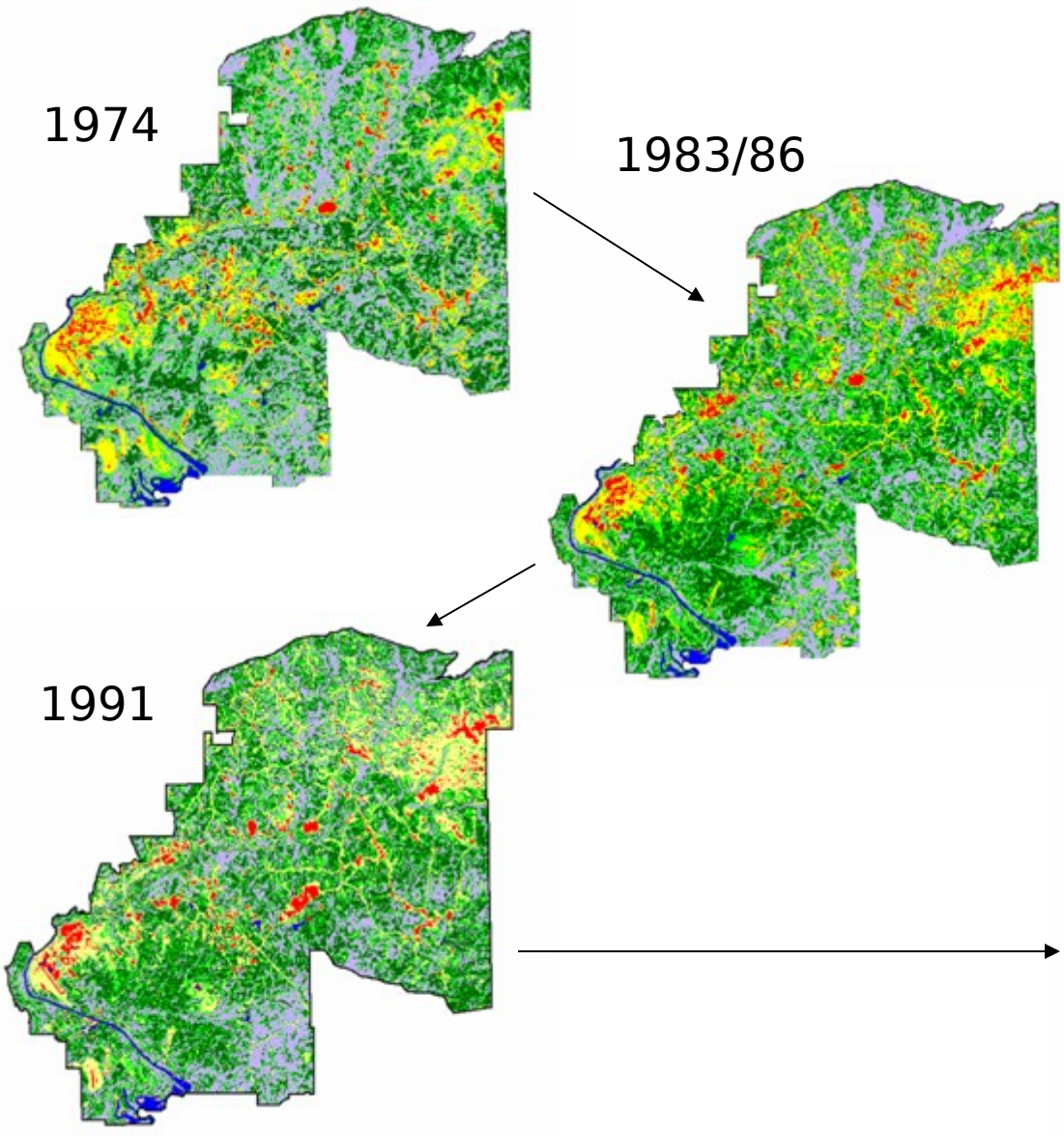


Low disturbance

High disturbance

Candidate Indicators for Entire Installation

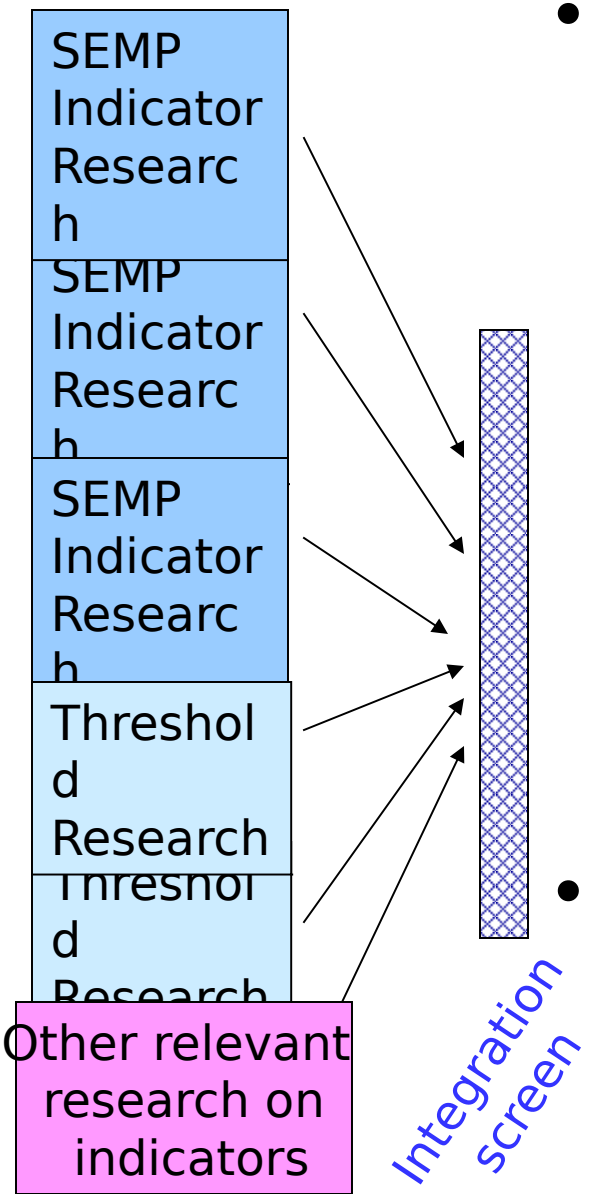
- Landscape metrics:
  - total edge (m)
  - landscape composition
  - number of habitat patches
  - descriptors of patch area
  - nearest neighbor distance
  - clumpiness


1974
1983/86
1991
1999
Ft. Benning
Land Cover Classification Key
Bare ground or developed areas such as buildings. (highly reflective surfaces)
Non-forest or cleared areas. (ground cover present, includes lawns)
Deciduous forest (dense)
Mixed forest (areas of deciduous and pine, widely spaced or sparse forest cover and transitional areas between forest and non-forest)
Pine forest (dense)
Water

(60 m resolution)

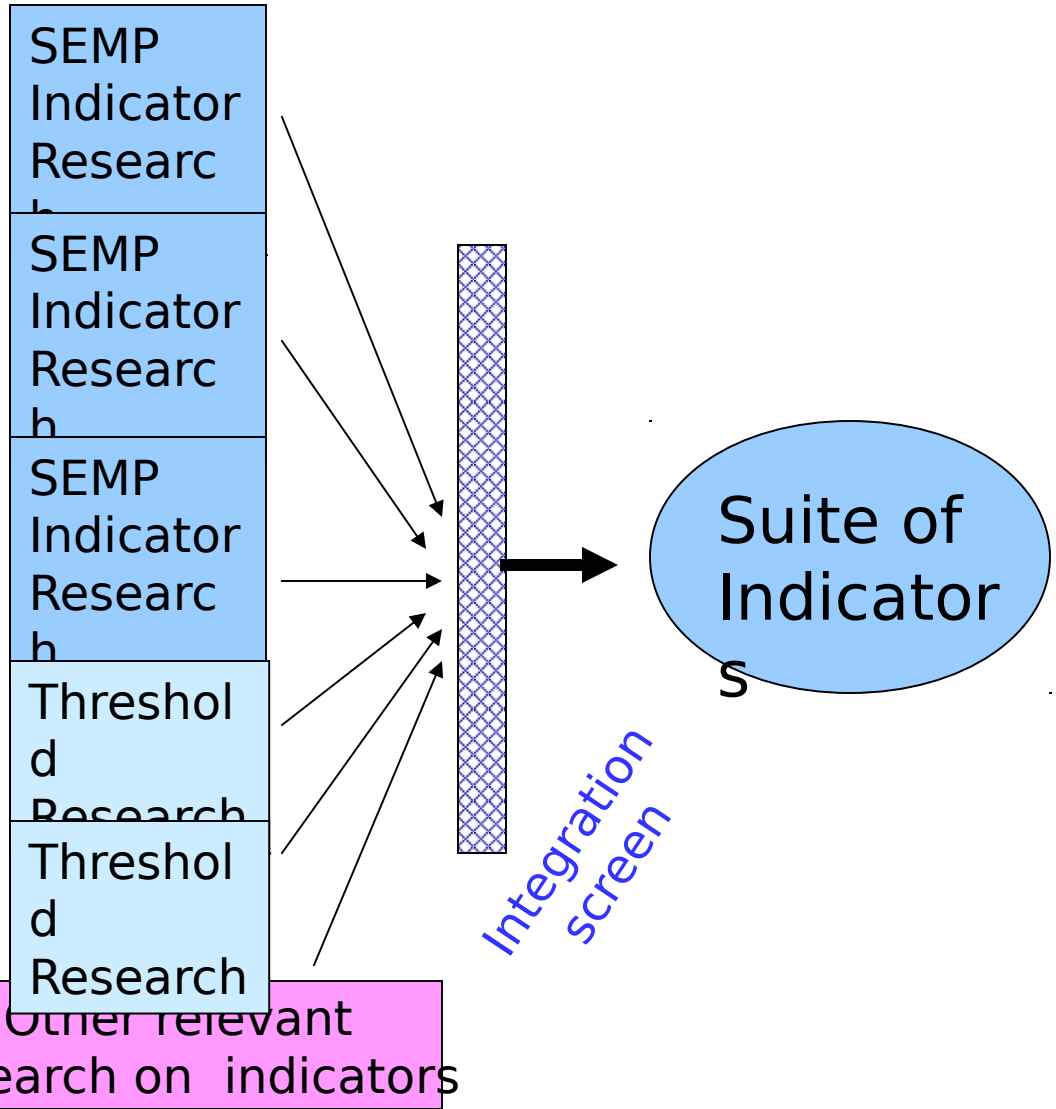
(30 m resolution)

Next steps to integration

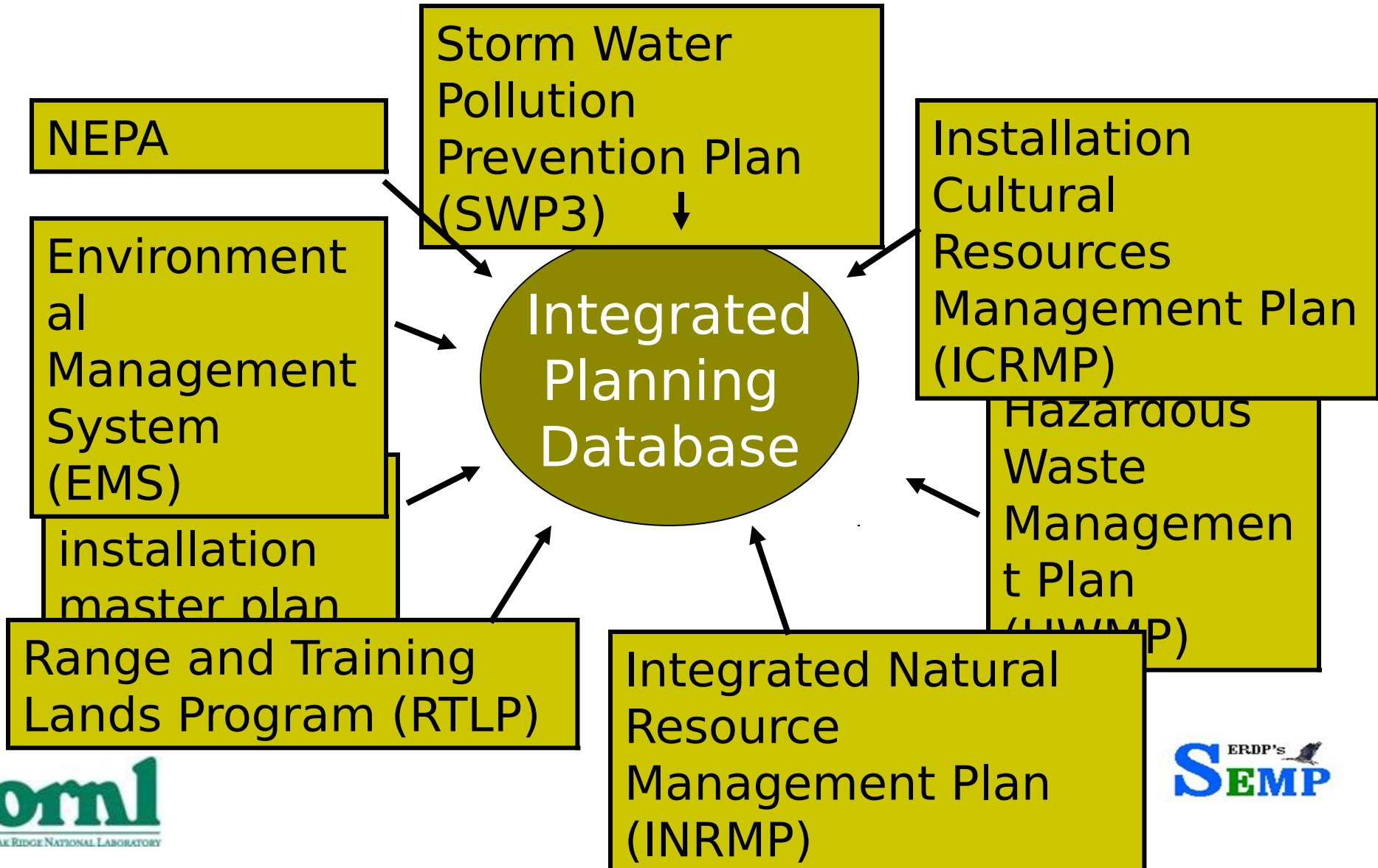


- Query the three indicator and two threshold research teams as to their proposed indicators -- including the
  - Protocol for collecting information
  - Units of measure
  - Spatial and temporal applicability of measure
  - Means of analyzing and interpreting metrics
- Conduct a preliminary screening of proposed metrics against the criteria for indicators

Components of SEMP Integration



Indicators must be put in context of management needs

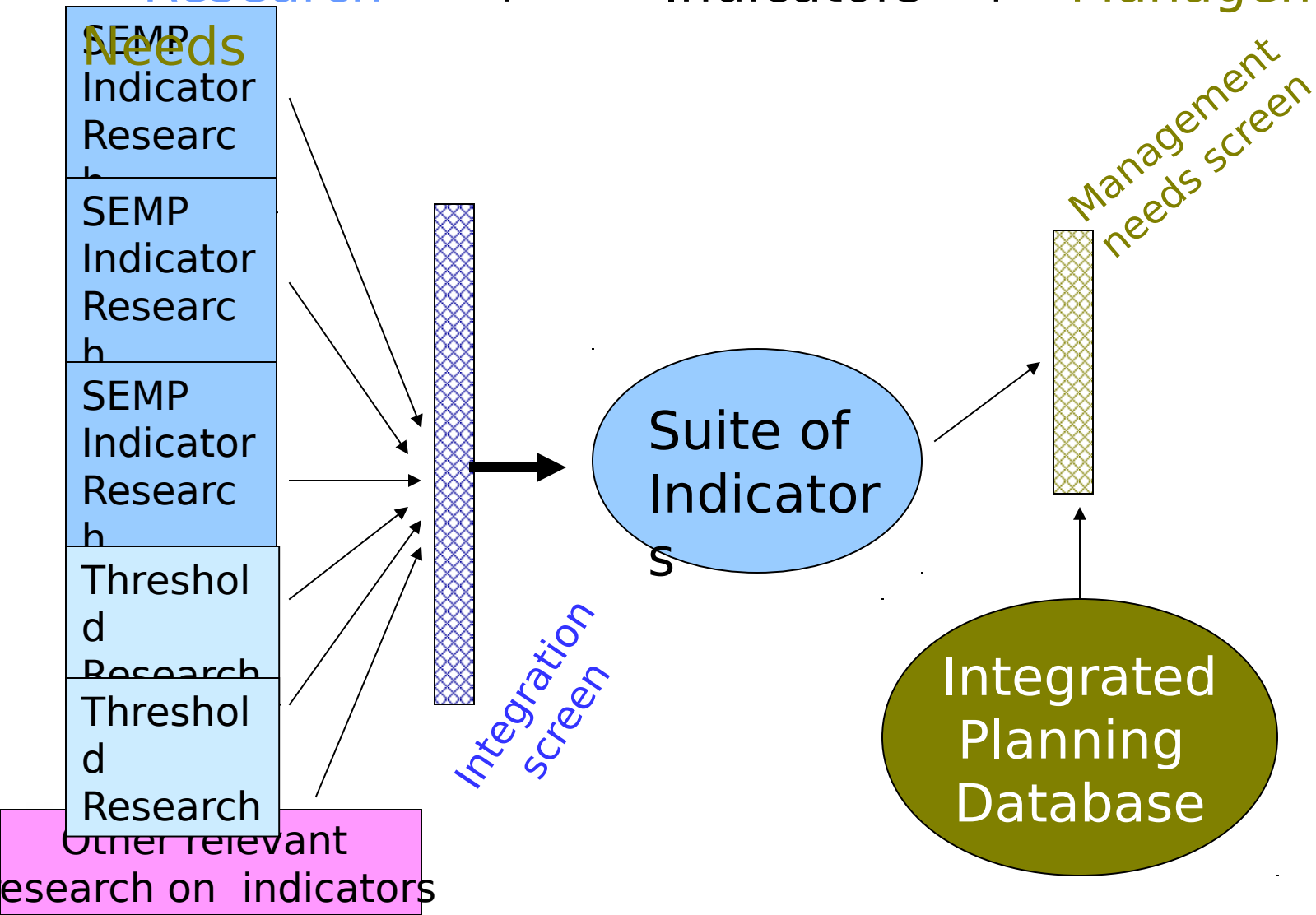

Storm Water Pollution Prevention Plan (SWP3)
NEPA
Environmental Management System (EMS)
installation master plan
Range and Training Lands Program (RTLP)
Integrated Planning Database
Installation Cultural Resources Management Plan (ICRMP)
Hazardous Waste Management Plan
Integrated Natural Resource Management Plan (INRMP)

ornl
Oak Ridge National Laboratory

ERDP's SEMP

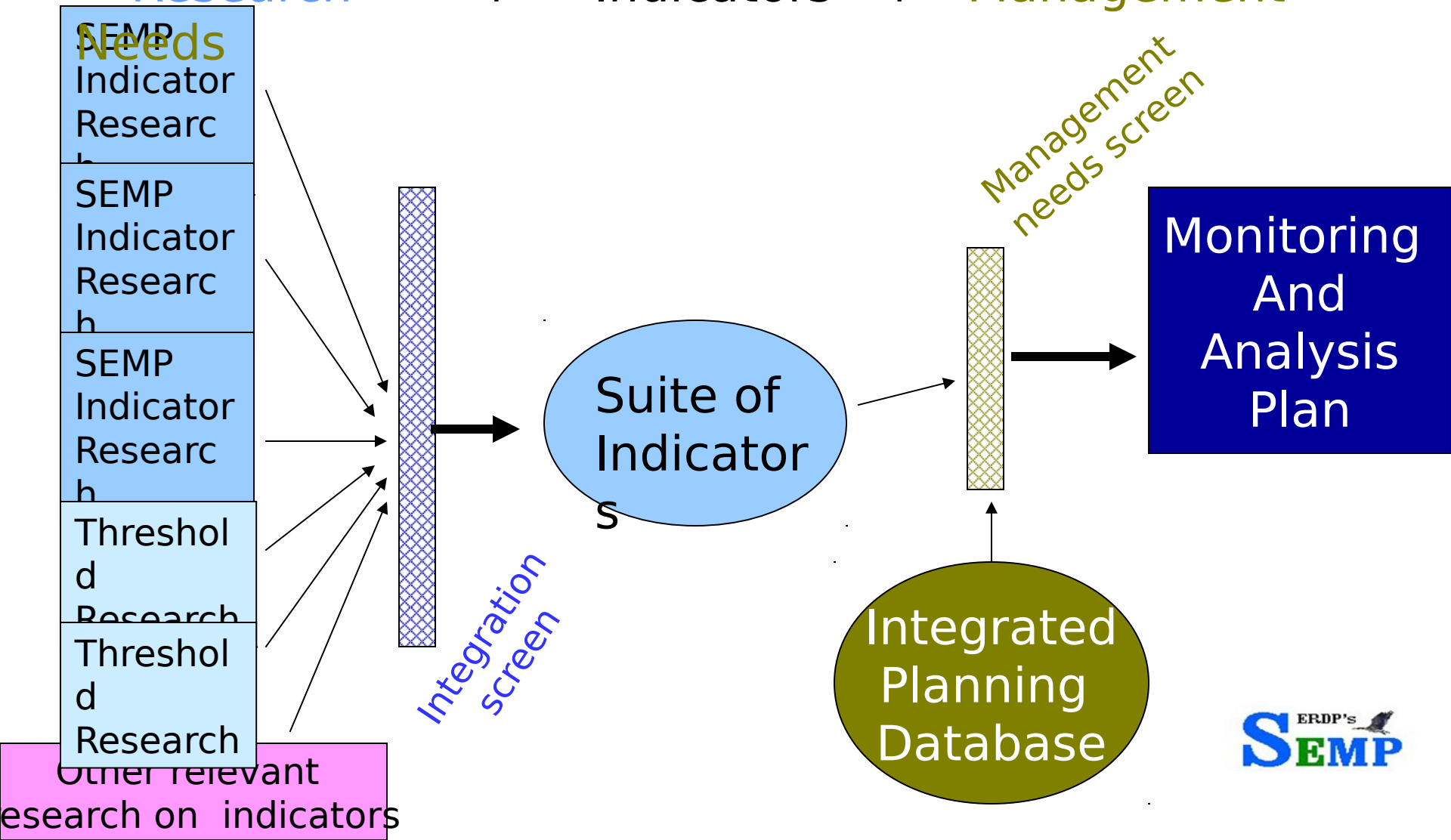
SEMP Integration

= Research + Indicators + Management



Result of SEMP Integration is plan for monitoring and analysis

= Research + Indicators + Management



DoD EPA DOE SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

ERDP's SEMP IP

ornl
Oak Ridge National Laboratory

ERDP's SEMP